

**REMARKS**

This is a full and timely response to the outstanding FINAL Office Action mailed February 13, 2007. The Examiner is thanked for the thorough examination of the present application. Upon entry of this response, claims 1-18 are pending in the present application. The Office Action sets forth the following rejections:

- (1) Claims 1-18 are rejected under 35 U.S.C. §101 as allegedly being directed to non-statutory subject matter.
- (2) Claim 1 is rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Ewins* (U.S. Pub. No. 2002/0126133, hereinafter "*Ewins*"), in view of *Ewins* ("*Mip-Map Level Selection for Texture Mapping*"; IEEE Transactions on Visualization and Computer Graphics, Oct-Dec 1998, p. 317-319).
- (3) Claims 2-3, 6-8, 10 and 13 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Ewins*, in view of *Ewins*, further in view of Rosman et al. (U.S. Pat. No. 6,184,894, hereinafter "*Rosman*").
- (4) Claims 9 and 11 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Ewins*, in view of *Ewins*, further in view of Van Hook et al. (U.S. Pat. No. 6,353,438, hereinafter "*Van Hook*").
- (5) Claims 4 and 5 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Ewins*, in view of *Ewins*, further in view of *Rosman*, further in view of Barenburg et al. (U.S. Pub. No. 2005/0128213, hereinafter "*Barenburg*").

- (6) Claims 14 and 16 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Ewins*, in view of *Ewins*, further in view of *Rosman*, further in view of Lin et al. (U.S. Pat. No. 5,740,344, hereinafter "*Lin*").
- (7) Claim 15 is rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Ewins*, in view of *Ewins*, further in view of *Rosman*, further in view of Spangler (U.S. Pub. No. 2004/0119720, hereinafter "*Spangler*").
- (8) Claim 17 is rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over *Ewins*, in view of *Ewins*, further in view of *Rosman*, further in view of Lin, further in view of Burrell (U.S. Pub. No. 2001/0048443, hereinafter "*Burrell*").

Applicants respectfully request consideration of the following remarks contained herein. Reconsideration and allowance of the application and presently pending claims are respectfully requested.

#### **I. Allowable Subject Matter**

Applicants would like to first thank the Examiner for indicating on page 14 that claims 12 and 18 contain allowable subject matter and would be allowable if rewritten into independent form including all the limitations of the base claim and any intervening claims. At this time, however, Applicants have not amended these claims and respectfully ask for consideration of the remarks presented below.

**I. Response to Claim Rejections Under 35 U.S.C. § 101**

Claims 1-18 stand rejected under 35 U.S.C. §101 as allegedly being directed to non-statutory subject matter. In the “Response to Arguments” section, the Office Action maintains that claim 1 allegedly fails to produce a useful, concrete and tangible result. Applicants appreciate the Examiner’s recommendation of adding the feature of displaying the results of said filtering effect. However, Applicants feel that the following amendment may be more appropriate: “A method of reducing the number of texture cache cycles while performing anisotropic mip-mapping, comprising: . . . wherein simulating the filtering effect reduces the number of cache memory cycles associated with the filtering function.”

Indeed, the reduction of cache memory cycles is one of the objectives that the present invention addresses in the specification and seeks to achieve. Applicants submit that claim 1, as amended, does produce a useful, concrete and tangible result. Applicants reiterate that the claimed embodiments use only one level of a mip-map to perform filtering functions. Using one level instead of two levels avoids the need to load another level of texels into the cache memory. This would otherwise require an additional memory cycle. As appreciated by those skilled in the art, graphics processing is computationally intensive in nature. Therefore, any reduction in cache memory cycles and any increase in the cache hit rate increases the overall performance in a graphics system. Accordingly, Applicants respectfully request that the 35 U.S.C. §101 rejections to claims 1-18 be withdrawn.

## II. Response to Claim Rejections Under 35 U.S.C. § 103

Claims 1-18 stand rejected under 35 U.S.C. §103(a). For at least the reasons set forth below, Applicants traverse these rejections.

### **Independent Claim 1 is Patentable Over Ewins in View of Ewins**

Applicants respectfully submit that independent claim 1 patently defines over the combination of *Ewins* and *Ewins* for at least the reason that the combination fails to disclose, teach or suggest certain features in claim 1.

Claim 1, as amended, recites (emphasis added):

1. A method of reducing the number of texture cache cycles while performing anisotropic mip-mapping, comprising:  
***mapping a target pixel needing texture to one or more texels in a higher resolution texture array, a region of support in the higher resolution texture array being defined by a long and a short axis and being generally elliptical and a level of detail being derived only from the short axis***; and  
***performing a filtering function*** along an axis using the texels from the higher resolution texture array to simulate a filtering effect of using texels from the higher resolution texture array and a second texel array having a lower resolution, ***wherein only one level of texture level is stored and used to generate the lower resolution texture array***, and wherein simulating the filtering effect reduces the number of cache memory cycles associated with the filtering function.

Claim 1 patently defines over the cited art for at least the reasons that the cited art fails to disclose the features emphasized above. Claim 1 defines the feature of: “mapping a target pixel.....defined by a long and a short axis and...and **a level of detail being derived only from the short axis**.” On page 4, the Office Action relies on the *Ewins* reference (US2002/0126133) to teach this feature (emphasis added):

*Ewins* ('133) teaches mapping a target pixel needing texture to one or more texels in a higher resolution texture array, a region of support in the higher resolution texture array being defined by a long and a short axis

and being generally elliptical and **a level of detail being derived from the short axis** (p. 1 paragraph 17-p.2 paragraph 23, p. 2-3 paragraph 35-31, Fig. 1A)

In the “Response to Arguments” section on page 3, the Office Action points out that claim 1 does not require deriving a LOD **only** from the short axis. As indicated above, Applicants have thus amended claim 1 to specifically recite this feature and respectfully submit that *Ewins* (US2002/0126133) does not teach this feature. Instead, *Ewins* (US2002/0126133) states in Col. 2, paragraph 23 (emphasis added):

The present application describes methods for trilinear MIPmap filtering wherein **the LOD parameter is based on an interpolation** (e.g. an average) which is **a function of both major-axis and minor-axis minification**.

Furthermore, FIG. 1A of *Ewins* clearly shows how the LOD is derived from both the major and minor axes:

$$\text{lod} = f((\text{major} + \text{minor}) \gg 1)$$

While FIG. 1B shows the LOD as a function of the major axis, *Ewins* still fails to teach of the LOD as a function of only the minor axis. Thus, Applicants submit that claim 1 clearly defines over *Ewins* (US2002/0126133) as the derivation of the LOD is different between the two. Specifically, *Ewins* (US2002/0126133) does not teach or suggest the limitation of deriving LOD from the **short axis only**. Accordingly, Applicants submit that neither of the *Ewins* references teach the features emphasized in claim 1 above.

As a separate and independent basis for the patentability of claim 1, claim 1 further recites “wherein only one level of texture level is stored and used to generate the lower resolution texture array.” In the “Response to Arguments” section, the Examiner disagrees with the Applicants that the *Ewins* reference (“Mip-Map Level Selection for Texture Mapping”) fails to teach this feature. Applicants maintain that *Ewins* fails to

teach this feature and respectfully request that the Examiner consider the following remarks clarifying Applicants' earlier response.

As noted in the present Office Action, the *Ewins* reference does indeed discuss progressively averaging groups of four neighboring texels to form each new layer of the image pyramid, wherein this process is continued from the initial, full detail, or base texture level. (p. 318, §1.1) However, this portion of the *Ewins* text appears to relate to the initial construction or derivation of the mip-map and not to the actual texture filtering process which later utilizes the mip-map. Applicants submit that one of the novel aspects of the present invention relates to performing a filtering function wherein only one level of texture level is stored and used to generate the lower resolution texture array. The end result is the reduction of cache memory cycles otherwise needed to perform the filtering process as this avoids the need to load the next level texels into the cache.

*Ewins*, on the other hand, does not appear to teach of storing only one level of texture level. During texture filtering, *Ewins* teaches that two prefiltered mip-map levels surrounding the calculated minification value are used in order to perform interpolation. Applicants refer the Examiner to the following text on page 318, §1.1 (emphasis added):

As illustrated in Fig. 3, the calculated minification value will frequently fall somewhere between two prefiltered MIPmap levels. For improved results, trilinear filtering is used. Here, bilinear interpolation is performed on both levels on either side of the calculated minification value. Trilinear interpolation is then achieved by linearly interpolating between the color values resulting from these two bilinear interpolations to the intermediate interpolation fraction  $f$  as shown. Trilinear filtering is one of the most commonly used methods of filtering in real-time hardware today. The filtering operation can be summarized as follows:

- 1) Receive the texture address  $s, t$  for the current screen pixel  $x, y$

- 2) Calculate the texture minification,  $j$
- 3) **Extract the level of detail or MIP-map levels to be used**, e.g., for a minification ratio of 6 to 1, the levels referring to minification ratios of 4 and 8 are used, **i.e., MIP-map levels 2 and 3 ( $l = 2$ )**
- 4) Calculate the trilinear interpolation fraction,  $f$
- 5) Scale the texture address  $s$ ,  $t$  for the levels selected
- 6) Perform trilinear interpolation

Thus, *Ewins* reference teaches of performing bilinear interpolation “**on both levels** on either side of the calculated minification value.” In step 3 above, *Ewins* teaches of extracting the LOD or mip-map levels to be used. Applicants maintain that there is no mention in the *Ewins* text of the following feature in claim 1: “mapping a target pixel needing texture . . . wherein only one level of texture level is stored and used to generate the lower resolution texture array.” Applicants therefore submit that the *Ewins* reference does not teach this feature.

For at least these reasons, Applicants respectfully submit that independent claim 1 patently defines over *Ewins* in view of *Ewins* for at least the reason that the combination fails to disclose, teach or suggest certain features in claim 1.

**Dependent Claims 2-18 are Patentable**

Applicant submits that dependent claims 2-18 are allowable for at least the reason that these claims depend from an allowable independent claim. See, e.g., *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988).

**CONCLUSION**

Applicants respectfully submit that all pending claims are in condition for allowance. Favorable reconsideration and allowance of the present application and all pending claims are hereby courteously requested. If, in the opinion of the Examiner, a telephone conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (770) 933-9500.

No fee is believed to be due in connection with this amendment and response to Office Action. If, however, any fee is believed to be due, you are hereby authorized to charge any such fee to deposit account No. 20-0778.

Respectfully submitted,

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